pyroscience
sensor technology

Profix

Microprofiling-Software for Microsensor Measurements

Instruction Manual

Document Version 4.6

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1 Introduction

1.1 System Requirements

- PC with Windows 2000/ XP/ Vista / 7 / 8
- Processor with >1.8 GHz
- 200 MB free hard disk space
- Motorized micromanipulator from ***PyroScience***
  (e. g. *Micromanipulator MU1*), requires USB-port
- Microsensor modules:
  - ***FireStingO2*** (optical oxygen meter) from ***PyroScience***
    requires USB-port
  - *Dual Channel Reader* ***DCR16*** from ***PyroScience***
    (data acquisition module with 2 voltage inputs), requires USB-port

1.2 General Features of *Profix*

Profix is a program for automated microsensor measurements. It can read data from two different microsensor modules. In addition, ***Profix*** can control motorized micromanipulators from ***PyroScience***. The central feature of the program is automated microprofile measurements. The user defines the (i) starting-depth, (ii) the end-depth, and (iii) the step size of the desired microprofile. Thereafter the computer will control the complete microprofiling process. The timing-schemes can be adjusted in detail. Automated long-term measurements can easily be set up (e.g. performing a microprofile measurement every hour for several days). If the micromanipulator is additionally equipped with a motorized x-axis (e.g. ***MUX2***), ***Profix*** can also perform automated transects measurements. Basic features of the program are:

- Strip chart indicators for display of actual microsensor readings
- Microsensor calibration
- Manual motor control
- Manual data acquisition
- Logging at defined time intervals
- Fast microprofiling
- Standard microprofiling
- Automated transects
- Adjustable timing schemes
- Inspection of old data files

2 Safety Guidelines

PLEASE READ THESE INSTRUCTIONS CAREFULLY BEFORE STARTING TO WORK WITH THIS PRODUCT

- If there is any reason to assume that the instrument can no longer be operated without a risk, it must be set aside and marked appropriately to prevent any further use.

- The user has to ensure the following laws and guidelines:
  - EEC directives for protective labor legislation
  - National protective labor legislation
  - Safety regulations for accident prevention

THIS DEVICE MAY ONLY BE OPERATED BY QUALIFIED PERSONAL:

This device is only intended for use in the laboratory by qualified personal according to this instruction manual and these safety guidelines!

Keep this product out of the reach of children!

This product is not intended for medical or military purposes!

3 Installation

3.1 Software Installation

IMPORTANT: Always perform the installation in the administrator mode!

Download the newest installer package from

http://www.pyro-science.com/downloads.html

Start the installation program "setup.exe" in the folder "Installer Profix". Follow the installation guidelines.

The installation adds a new program group "Pyro Profix" to the start-menu, where you can find the program ***Profix***. Additionally, a shortcut is added to the desktop.

3.2 Assembling the Measuring Setup

A standard setup of a microprofiling system consists of (i) a motorized micromanipulator and (ii) one or two microsensor modules from ***PyroScience***. In the following sections you can find instructions for integrating the different components into the microprofiling setup.

3.2.1 Micromanipulator *MU1* and *MUX2*

IMPORTANT: First install ***Profix*** before connecting the USB cable of the micromanipulator ***MU1*** for the first time to the computer!

Read carefully the instruction manual following with the Micromanipulators ***MU1*** and ***MUX2***. There their assembly, manual operation, and cabling is described in detail. Before connecting the micromanipulator to the power supply, ensure that the manual control knobs on the motor housings are turned into their centre positions (feel the slight detent!). Otherwise the motors would immediately start moving when connecting the power supply! After ***Profix*** is started, the manual control knob is by default deactivated, but can be again manually activated within the program.

It is important that you **first** install ***Profix*** **before** connecting the USB cable for the first time to the computer. So, if the ***Profix*** installation was successful, just connect the USB cable to the PC which will then automatically install the correct USB-drivers.

3.2.2 *FireStingO2*

IMPORTANT: First install *Profix* before connecting the USB cable of the *FireStingO2* for the first time to the computer!

The *FireStingO2* is a fiber-optic oxygen meter for high precision oxygen sensing with fiber-optic oxygen microsensors (optodes). It is a multipurpose oxygen meter that is compatible with a broad range of oxygen sensors from *PyroScience*. It is recommended to read carefully the user manual of the *FireStingO2* before integrating it into the microprofiling setup.

The PC software *Pyro Oxygen Logger* is available at

http://www.pyro-science.com/downloads.html

for operation of a *FireStingO2* in other applications than microprofiling. It is recommended that you get accustomed to the *FireStingO2* by using the *Pyro Oxygen Logger* (follow the instruction manual of the *FireStingO2*). However, for the operation with *Profix*, this software is principally not required and need not to be installed.

It is important that you **first** install *Profix* **before** connecting the USB cable of the *FireStingO2* for the first time to the computer. So, if the *Profix* installation was successful, just connect the USB cable to the PC which will then automatically install the correct USB-drivers.

3.2.3 Analog Input *FireStingO2*

IMPORTANT: First install *Profix* before connecting the USB cable of the *FireStingO2* for the first time to the computer!

Voltage signals in the range of 0-2.5 Volts from one channel of a (third-party) microsensor module can be read in via the extension port (connector X1) of the *FireStingO2* meter. For this, connect ground (GND) to pin 1, and the voltage signal to pin 7. Please refer to the manual of the *FireStingO2* for further details.

It is important that you **first** install *Profix* **before** connecting the USB cable of the *FireStingO2* for the first time to the computer. Please follow the instructions in the manual of the *FireStingO2* for connection to the extension port.

3.2.4 Dual Channel Reader *DCR16*

IMPORTANT: First install the ***DCR16*** driver software before connecting its USB cable for the first time to the computer!

The Dual Channel Reader ***DCR16*** provides an interface between the PC and voltage signals from microsensor meters. Up to two microsensor signals in the range of ±10 V are read at a maximum precision of 0.1 mV into the PC. An integrated hardware low-pass filter (cut-off frequency 10 Hz) removes possible interferences from the mains frequency 50/60 Hz. The ***DCR16*** is intended for microsensor meters which do not possess a built-in PC interface.

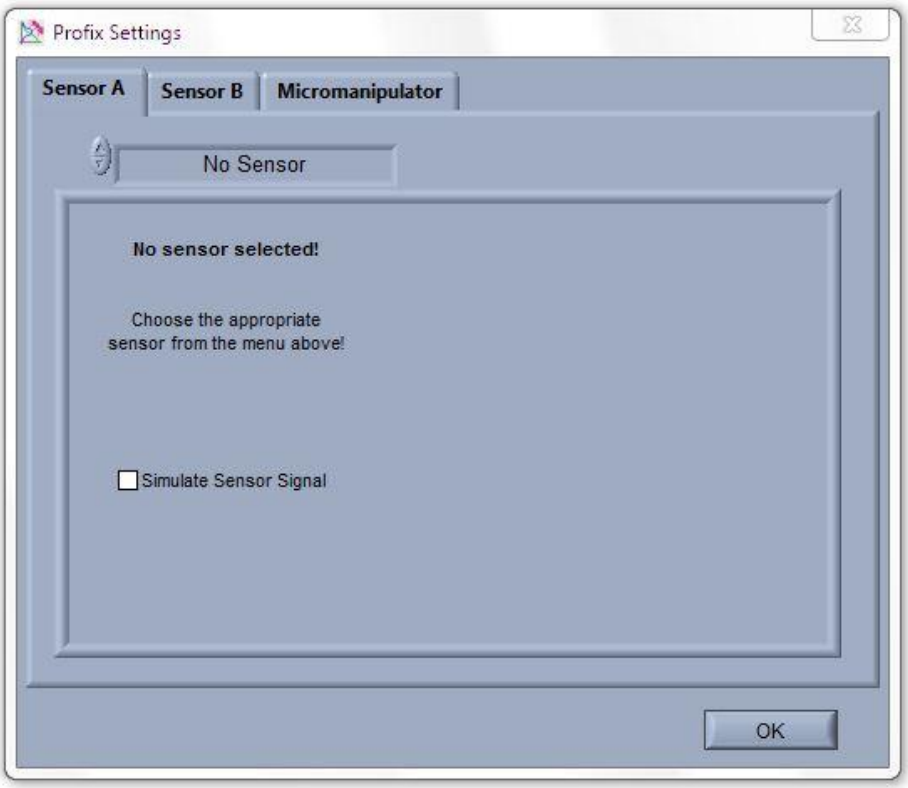
It is important to install first the ***DCR16*** driver software on the PC, before connecting it for the first time to the USB-port of the PC. Please follow the installation instruction following with the ***DCR16***.

4 Operation Instructions

Remark for the following sections: Words written in **bold** designate elements within the *Profix* user interface (e.g. button names).

4.1 Starting of *Profix* and Settings

After starting *Profix* the settings in the three tabs (**Sensor A, Sensor B, Micromanipulator**) of the window **Profix Settings** have to be adjusted:

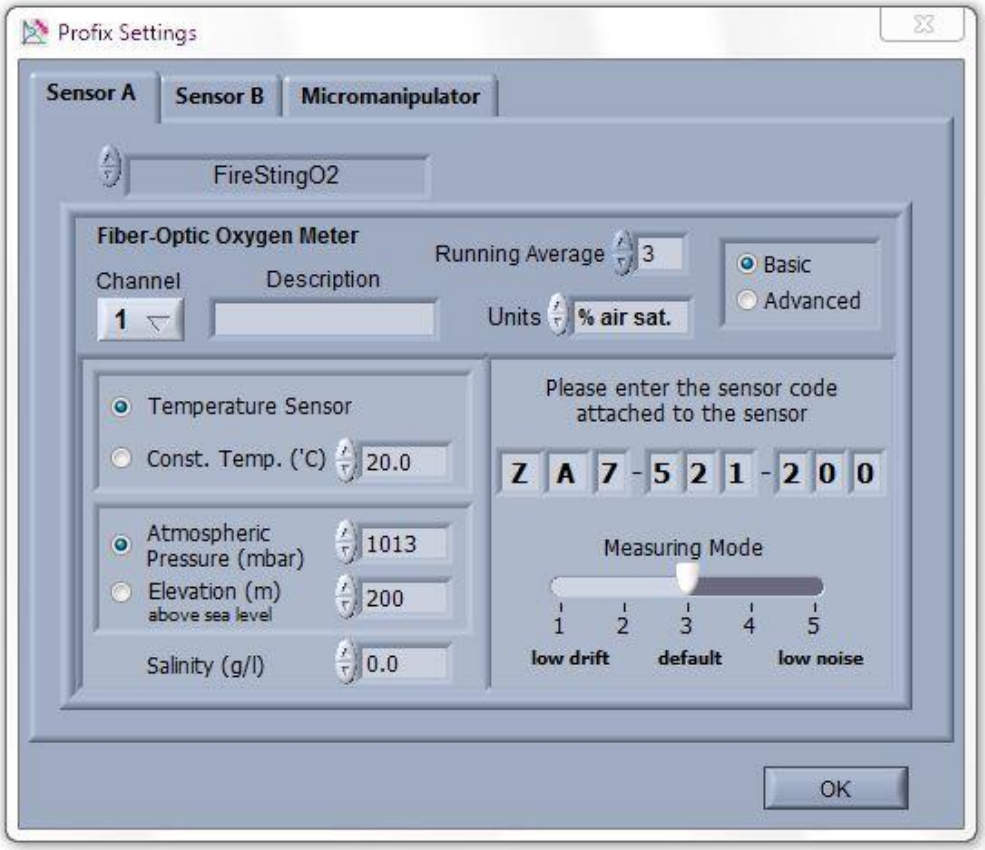


Profix reads up to two microsensor signals, which are designated within the program as **Sensor A** and **Sensor B**. In the tabs **Sensor A** and **Sensor B** of the **Profix Settings**, different microsensor modules (*FireStingO2*, Dual Channel Reader *DCR16*, Analog Input *FireStingO2*) can be selected. For each sensor the **Running Average** has to be adjusted. The running average defines the time interval in seconds over which the sensor signal is averaged. If only one microsensor module will be used, just leave the one channel (e.g. Sensor B) as "No Sensor".

4.1.1 *FireStingO2*

If the ***FireStingO2*** is selected as microsensor module different settings have to be adjusted:

Channel defines the oxygen channel number of the ***FireStingO2*** to which the microsensor is connected. **Description** allows a short description of the sensor type or application which will be saved into the data file. The oxygen units of the measurements can be selected (for each channel) by the selector **Units**. The selectable units include raw value[1], % air saturation, $\%O_2$, mL L^{-1}, µmol L^{-1}, mg L^{-1} (ppm), hPa (mbar), Torr (mmHg) and dphi. For measurements in a Gas Phase only the units raw value, $\%O_2$, hPa (mbar), Torr (mmHg) or dphi should be selected, whereas for measurements in a Water Sample all units except $\%O_2$ should be selected.



The Settings Mode has to be chosen as **Basic** or **Advanced**. The first time user is advised to work with the **Basic** Settings. If **Basic** is chosen, please enter the sensor code attached to the sensor. For **Advanced** Settings please refer to the Manual of the ***FireStingO2***.

The **Measuring Mode** can be adjusted gradually between low drift (1) and low noise (5) of the sensor signal by moving the arrow with the mouse along the scale, thereby changing the oxygen measuring time. An intermediate mode (3) is default.

[1] raw value=uncalibrated sensor readings (only qualitative information)

The next step is the determination of the environmental conditions in the sample. It needs to be selected if during the measurements the temperature will be determined by the **Temperature Sensor** connected to the ***FireStingO2*** or if measurements are performed under a **Constant Temperature**. If **Temperature Sensor** is selected, automatic temperature compensation of the respective oxygen sensor readings is activated (for details refer to the Manual of the ***FireStingO2***). If **Const. Temperature (°C)** is chosen, the temperature of the environmental sample has to be determined with an external thermometer or with a temperature sensor from ***PyroScience*** connected to the ***FireStingO2***, and has to be adjusted ***manually***.

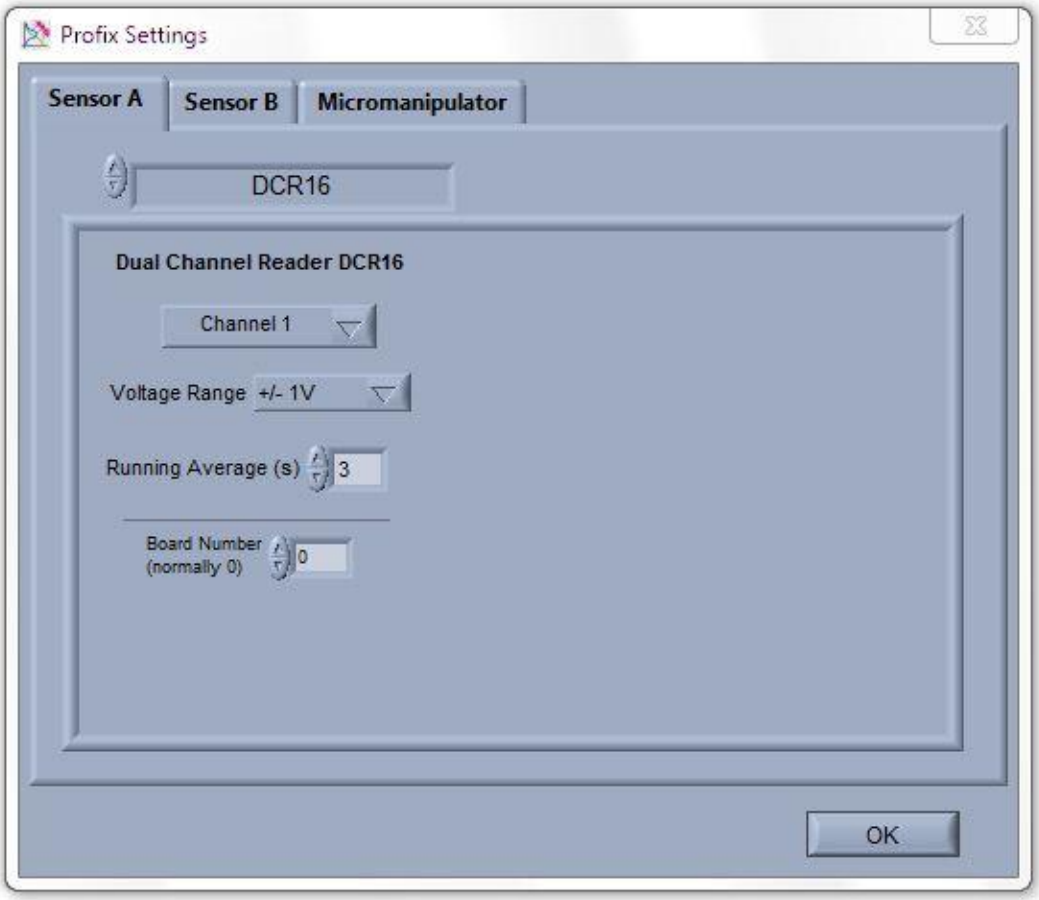
The **Atmospheric Pressure (mbar)** should be determined with a barometer and changed in the software under conditions of increased/decreased pressures, e.g. if measurements are performed in locations above or below sea level. Normal conditions refer to 1013 mbar (default setting).

If the actual atmospheric pressure cannot be determined on site, it is also possible to enter the **Elevation** in meters **(m) above sea level**. For this click on **Elevation** and enter the actual elevation. This procedure will only calculate the average atmospheric pressure for this elevation; therefore this option is less precise than measuring the actual atmospheric pressure.

The **Salinity** of the environmental sample (in g L^{-1}), in which the oxygen measurements will be performed, needs to be adjusted e.g. in case of saline water. For measurements in gaseous samples this value has no relevance.

4.1.2 Dual Channel Reader *DCR16*

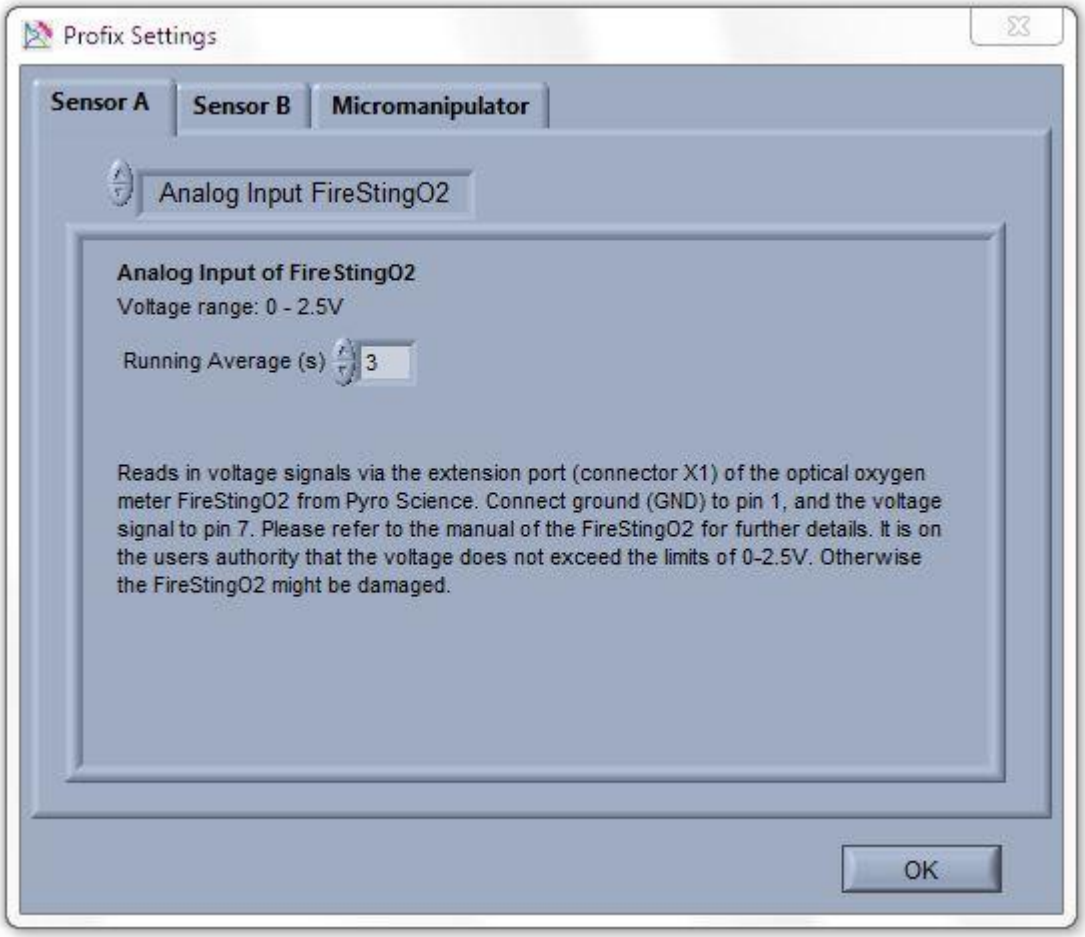
If the Dual Channel Reader *DCR16* is selected as microsensor module, different Settings have to be adjusted:



The **Channel** at the *DCR16* has to be selected and the **Voltage Range** for the measurements, as well as the **Running Average**.

4.1.3 Analog Input *FireStingO2*

If the Analog Input of the *FireStingO2* is selected, only the **Running Average** has to be adjusted for the measurements:


Profix Settings
Sensor A
Sensor B
Micromanipulator
Analog Input FireStingO2
Analog Input of FireStingO2
Voltage range: 0 - 2.5V
Running Average (s)
3
Reads in voltage signals via the extension port (connector X1) of the optical oxygen meter FireStingO2 from Pyro Science. Connect ground (GND) to pin 1, and the voltage signal to pin 7. Please refer to the manual of the FireStingO2 for further details. It is on the users authority that the voltage does not exceed the limits of 0-2.5V. Otherwise the FireStingO2 might be damaged.
OK

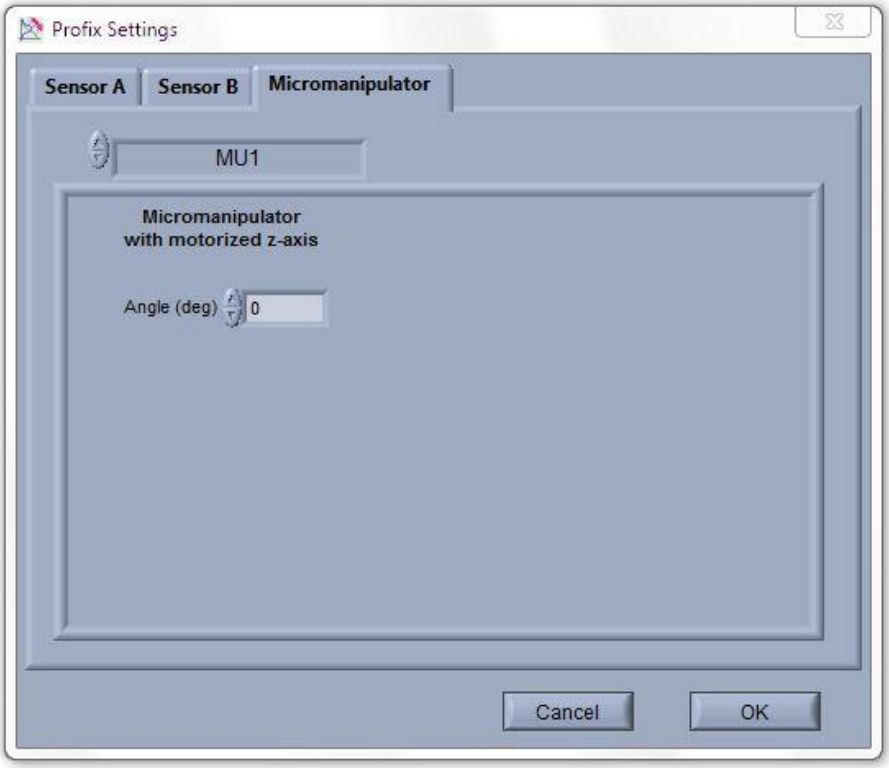
Please refer to the manual of the *FireStingO2* for connection to the extension port and further details.

NOTE: the Analog Input of the *FireStingO2* can only read in voltage signals from a third-party microsensor module in the range of **0-2.5 Volts**. It is on the users' authority to avoid that the voltage exceeds the limit of 2.5 V. A higher voltage can damage the *FireStingO2* irreversibly.

4.1.4 Micromanipulator

In the tab **Micromanipulator** of the window **Profix Settings,** the settings for the motorized micromanipulator can be found.

Select the appropriate **Micromanipulator**. **Angle (deg)** is the angle in degrees between the microsensor and the surface normal of the sample under investigation (not available for ***MUX2***). This value is "0" if the microsensor penetrates the surface perpendicular. All depths used by ***Profix*** are real depths inside the sample measured perpendicular towards the surface. The actual distances the motor has to move are calculated by correcting the real depths with the value of **Angle**.



For example if the microsensor penetrates the sample with an angle of 45° and the user wants to move the microsensors 100 µm in depth, the motor actually moves the sensor 141 µm along its longitudinal axis.

For testing and training purposes it is possible to operate ***Profix*** without any equipment connected. Just select "No Sensor" under **Sensor A** and **Sensor B,** and "No Motor" under **Micromanipulator,** and check the **Simulate Sensor Signal** and **Simulate Motor** boxes. This will simulate oscillating sensor signals, which might be helpful for performing some test runs with ***Profix***.

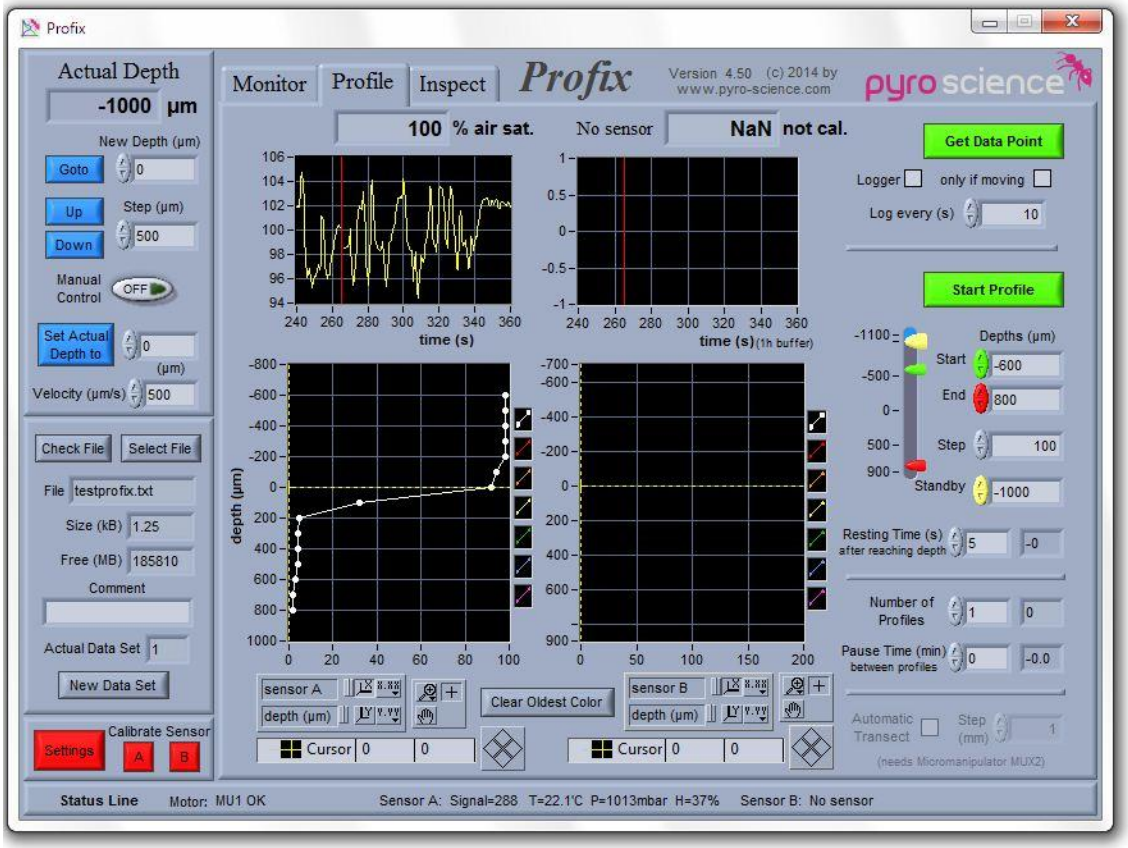
After pressing **OK** in the **Profix Settings** window, a file has to be selected in which the data of the microsensor measurements should be stored. If an existing file is chosen, the user is asked either to append new data to the file or to overwrite it completely. Finally, the main window of ***Profix*** is shown.

The settings can be adjusted any time by pressing the **Settings** button in the

main window. When closing ***Profix***, the settings are automatically saved for the next start-up.

4.2 Overview of *Profix*

The main window of *Profix* is divided into several areas. The area to the left is always visible and contains the manual control buttons for the micromanipulator **(blue buttons)**, the file handling buttons **(grey buttons)**, and the buttons for opening the Settings and Calibration windows **(red buttons)**. The area to the right can be switched between three tabs. The **Monitor** tab shows two chart recorders indicating the actual readings of the two channels. The **Profile** tab is used for manual data acquisition, logging in defined time intervals, fast and standard profiling. Finally, already acquired data sets can be reviewed in the **Inspect** tab.



The **Status Line** shows information of the connected motor and the connected oxygen microsensors (Sensor A, Sensor B). Here the signal intensity (Signal) of the oxygen microsensor readings and the readings from the temperature sensor connected to the *FireStingO2* (if used) can be found. Furthermore, if using a second generation *FireStingO2* meter (micro-USB connection), the readings of the integrated pressure and humidity sensors are also shown.

4.3 Manual Motor Control

All depth values indicated in the manual motor control box represent the real depth in the sample (see section 4.1.4 under **Angle**) and are always given in units of micrometers. **Actual Depth** indicates the current depth position of the microsensor tip. If **Goto** is pressed, the microsensor will be moved to a new depth chosen in **New Depth**. If either **Up** or **Down** is pressed, the microsensor will be moved one step up or down, respectively. The step size can be set in **Step**.

While the motor is moving, the background of the **Actual Depth** indicator turns red and a red **STOP Motor** button appears. The motor can be stopped any time by pressing this button. The velocity of the motor can be set in **Velocity** (range 1-2000 µm/s for ***MU1*** and ***MUX2***). The maximum speed should only be used for traveling larger distances. For the actual microprofiling measurements speeds around 100-200 µm/s are recommended.

A new depth reference point can be chosen by entering a depth value into the control box next to the **Set Actual Depth** button. After pressing this button, the **Actual Depth** indicator will be set to the entered value. A convenient way to establish a reference point is to move the microsensor tip to the surface of the sample using the **Up** and **Down** buttons with relevant step sizes. When the sensor tip is touching the surface, type "0" next to the **Set Actual Depth** button and click this button. The **Actual Depth** indicator will be set to zero. Assuming also that the correct value for **Angle** was entered in the settings (see section 4.1.4), all other depth values in the program are now taken as real depths in the sample.

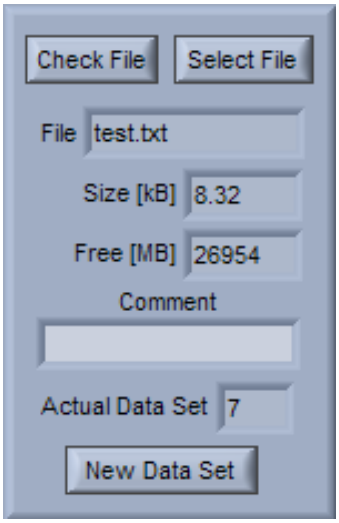
The **Manual Control** switch allows to enable or disable the manual control knob on the motor housings. These control knobs allow an easy way, for a fast rough positioning of the motors. The maximum speed (control knob fully turned to left or right) is still given by the settings in **Velocity.** ***Profix*** will give an acustical warning (beeps in 1 second intervals), if a motor is operated this way. During a profiling process, the manual control knob is by default deactivated.

REMARK for **Micromanipulator** ***MUX2*****:** The program elements described in this section control only the motor of the z-axis (up-down). In order to move the motor of the x-axis (left-right), enable the **Manual Control** switch and use the manual control knob on the motor housing.

4.4 File Handling

IMPORTANT: Always keep the text file (*.txt) and the binary data file (*.pro) in the same directory!

All data points acquired by *Profix* are always saved into a text file with the extension ".txt".



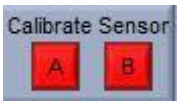
This file can be read by common spread sheet programs like Excel™. As separator characters *tab* and *return* are used. The current file name is indicated in **File**. Additionally, *Profix* generates in the same directory a binary data file with the extension ".pro". It is important that the text file and the binary data file remain within the same directory; otherwise the file cannot be re-opened in a later *Profix*-session. You can choose a new file by pressing on **Select File**. If an already existing file is selected, a dialog box asks, whether to append or to overwrite the existing data file. The size in kilobytes of the actual file is indicated in **Size**, while the space left in megabytes on the volume (e.g. hard disk C:) is indicated in **Free**. Under **Comment** the user can enter any text during the measurements, which will be saved together with the next data point acquired by *Profix*.

The data points saved in a file are separated in successive data sets by a header in the beginning of each data set. The header contains channel descriptions, date, time, data set number, and current parameter settings of *Profix*. The actual data set is indicated in **Actual Data Set**. A new data set can be generated manually by pressing **New Data Set**. The program generates automatically a new data set when a new profile is acquired by the standard profiling process. For a detailed discussion of data points and data sets refer to section 4.7.1.

If a channel is calibrated, the calibrated data are saved in separate columns. These columns are filled with "NaN" ("not a number") as long as the channel is not calibrated. The uncalibrated data are always saved.

By pressing **Check File**, a window is opened wherein the current data file is viewed as it would appear in a common spread sheet program. Maximally the last 200 lines of the data file are shown. The content of the window will be updated each time **Check File** is pressed again.

4.5 Sensor Calibration

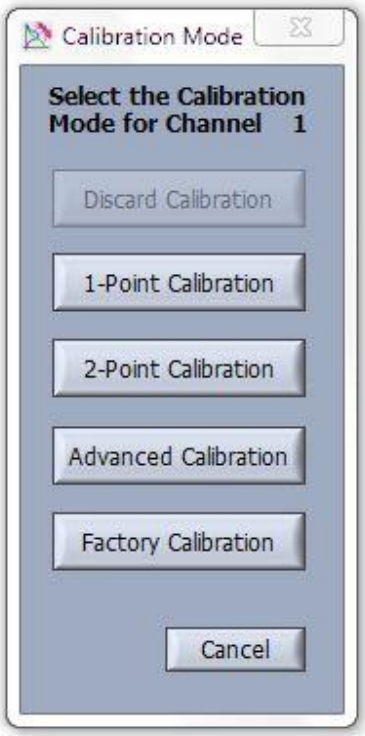


The calibration procedure is started by pressing the calibration buttons **A** or **B** for sensor A or sensor B, respectively. A separate calibration window will be opened. The following subsections will explain the calibration procedure for the different microsensor modules. The actual calibration is automatically saved on the hard disk if ***Profix*** is terminated. At the next start-up of ***Profix***, a dialog window opens for selecting (or rejecting): **Retrieve last calibration?**

4.5.1 Calibration with the *FireStingO2*

After clicking on **Calibrate Sensor A** or **B,** a dialog window opens in which the **Calibration Mode** for the corresponding channel can be selected.

The Calibration Modes comprise:



1-Point Calibration: taking the 0% value from the sensor code and the 100% value from a manual calibration

2-Point Calibration (recommended): taking the 0% and the 100% value from a manual calibration

Advanced Calibration: only for **advanced users**!

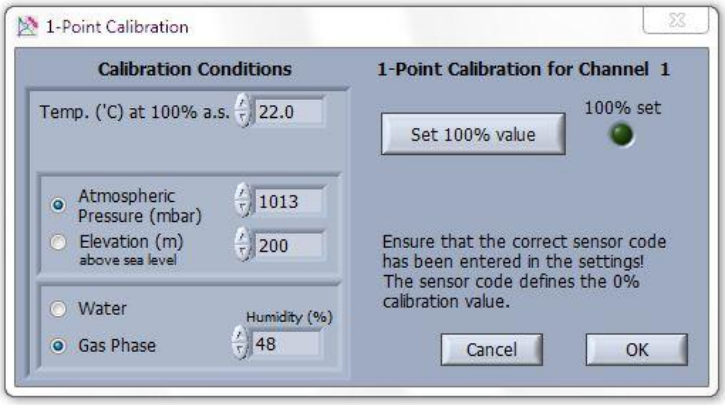
Factory Calibration (for a quick, rough calibration; only for testing purposes): taking the 0% and the 100% values from the sensor code.

Discard Calibration (active after a completed sensor calibration): deleting the actual calibration and thereby returning to un-calibrated raw values of the respective sensor readings in ***Profix***.

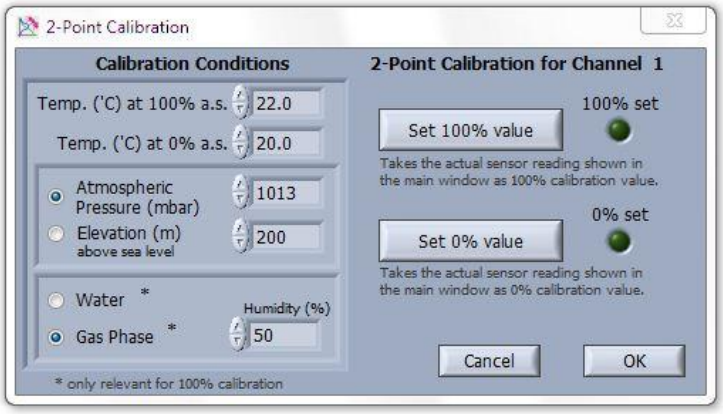
For more details concerning the Calibration Modes please refer to the Manual of the *FireStingO2*.

NOTE: The correct sensor code must have been entered before in the **Settings**. If "**Advanced"** sensor settings were chosen in the **Settings,** the dialog window **Calibration Mode** enables only a **2-Point Calibration** or **Advanced Calibration**.

The calibration of oxygen microsensors must be performed under constant and defined **Calibration Conditions**. The **Temperature** of the calibration standards and the **Atmospheric Pressure** needs to be determined and entered ***manually***.



For a **1-Point Calibration**, the Temperature of the calibration standard at 100% air saturation (a.s.) needs to be determined and entered ***manually***.



For a **2-Point Calibration**, the Temperature of the calibration standards at 100% and 0% air saturation needs to be determined and entered ***manually***.

NOTE: The calibration temperature is ***not*** read automatically from the temperature sensor, but it needs to be determined and entered ***manually***. Ensure constant calibration conditions! The actual readings of the temperature and, if using a second generation *FireStingO2* meter (micro-USB-connection), of the integrated pressure sensor are displayed in the **Status Line** of the *Profix* main menu and can be transferred ***manually*** (if they display the conditions in the calibration standard!).

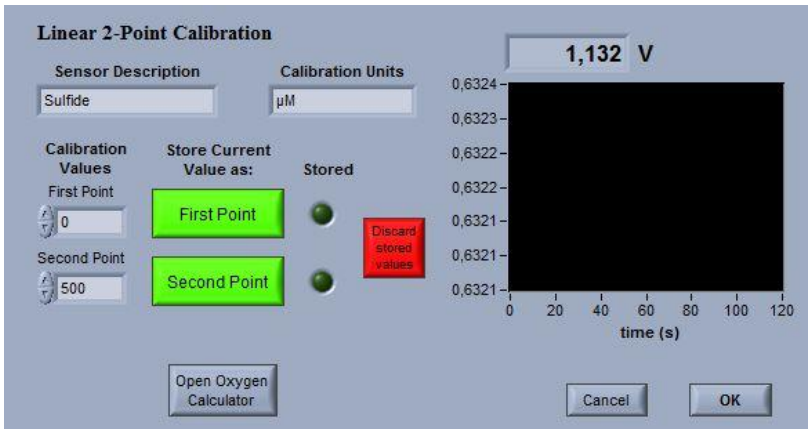
Depending on the 100% calibration standard used, select **Water** or **Gas Phase** (see Manual of the *FireStingO2*). In the latter case, the % of **Humidity** of the gas phase (e.g. air) needs to be determined with a hygrometer and entered. If a second generation *FireStingO2* meter is used, the readings of the integrated pressure sensor can be transferred ***manually*** from the **Status Line** of the *Profix* main menu if they display the conditions in the calibration standard (e.g. air)!

After adjusting the **Calibration Conditions**, insert the sensor into an appropriate 100% calibration standard, wait for a stable oxygen sensor reading and click on **Set 100% value**. The actual sensor reading is then taken as 100% calibration and the green indicator **100% set** lights up.

In case of a 2-Point Calibration, insert the sensor subsequently into the 0% calibration standard and after reaching stable readings click on **Set 0% value**. Now the actual sensor reading shown in the main window is taken as 0% calibration value and the green indicator **0% set** lights up. Both calibration values can be re-calibrated any time, simply by clicking again on **Set 100% value** or **Set 0% value**.

For more details concerning the calibration procedure and calibration standards please refer to the Manual of the *FireStingO2*.

4.5.2 Calibration with the Dual Channel Reader *DCR16*



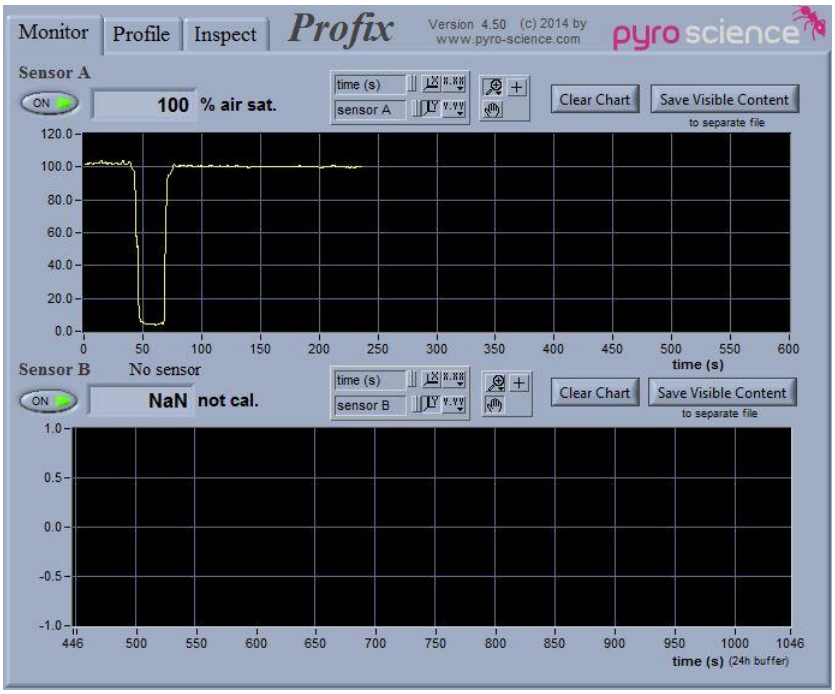
Microsensors connected to the Dual Channel Reader *DCR16* are calibrated by a linear two-point calibration. Insert an appropriate **Sensor Description** and the **Calibration Units.** Choose two calibration points and insert their values under **First Point** and **Second Point.** The microsensor is successively put into the two calibration liquids. The chart recorder indicates when the signal achieves a stable reading. By pressing **First Point** or **Second Point,** the current sensor reading is stored as a calibration point. The bright green indicators next to the calibration buttons indicate, that a calibration value has been **Stored**. By pressing **Discard stored values,** the actual calibration can be deleted and all readings in *Profix* for the respective sensor will be again un-calibrated values.

4.5.3 Calibration with the Analog Input of the *FireStingO2*

The calibration with the Analog Input of the *FireStingO2* meter is performed as described for the calibration with the Dual Channel Reader *DCR16* (see chapter 4.5.2).

4.6 The Monitor Tab

The Monitor tab contains two chart recorders for both sensors A and B. The actual reading of each sensor is indicated in the numerical display above the chart recorders. Depending on the calibration status it is given in **not cal.** units or in calibrated units. Each recorder can be switched on and off by pressing the oval **ON/OFF** button on the left side. The content of the chart recorders can be deleted by pressing the **Clear Chart** button.



NOTE: The data indicated in the chart recorders are not automatically saved to the hard disk.

There are several possibilities to change the range of the charts. The upper and lower limits of both axes can be changed by clicking with the mouse onto the limit tags, whereupon a new value can be typed in. Additionally, a tool panel is positioned above the chart:

The leftmost buttons X or Y provide auto-scaling for the x- or y-axis, respectively. This feature can also be permanently activated by clicking on the switches leftmost the buttons. The buttons X.XX and Y.YY can be used for changing the format, precision, or the mapping mode (linear, logarithmic).

The upper left button in the right box ("magnifying glass") offers several zoom options. After clicking the button with the hand, the user has the possibility to click onto the chart and move the whole area while keeping the mouse button pressed. During recording, the chart recorders will automatically adjust the x-range in such a way that the

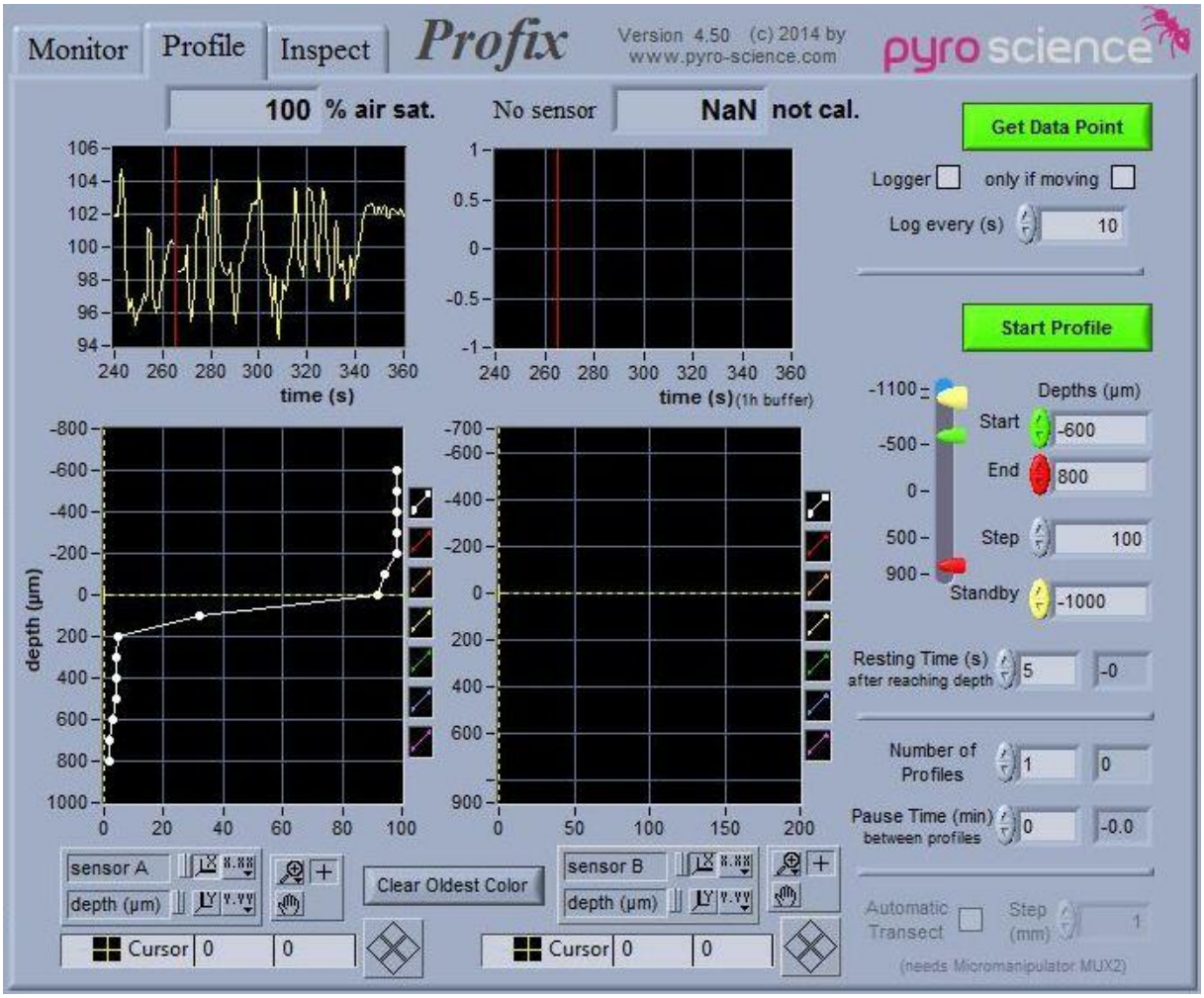
actual reading is visible. It might prevent the user from inspecting older parts of the chart. This problem can be avoided if the chart recorder is momentarily switched off by the oval **ON/OFF** buttons.

The sensor readings shown in the chart recorders are not automatically saved in the data files. For saving data points periodically, refer to section 4.7.3. However, it is possible to save the actual visible content of each chart recorder by clicking on **Save Visible Content**. The data are saved in two columns in a text file selected by the user. The text-file can be read by common spread sheet programs (separators: *tab* and *return*). The first column gives the time in seconds, the second column the channel readings.

By clicking with the right mouse button onto the black part of the chart recorder a pop-up menu appears, offering several functions. **Clear Chart** removes all old data shown in the chart recorder. Under **Update Mode** it is possible to select three different modes for the graphics updating, when the visible part of the chart recorder is filled up. In the first mode the visible part is continuously scrolled. The second mode clears the chart recorder and starts again at the beginning, whereas the third mode also starts at the beginning but overwrites the old data. The actual position is indicated by a vertical red line. The items **AutoScale X** and **AutoScale Y** function in exactly the same manner as the auto-scaling switches in the tool panel described above.

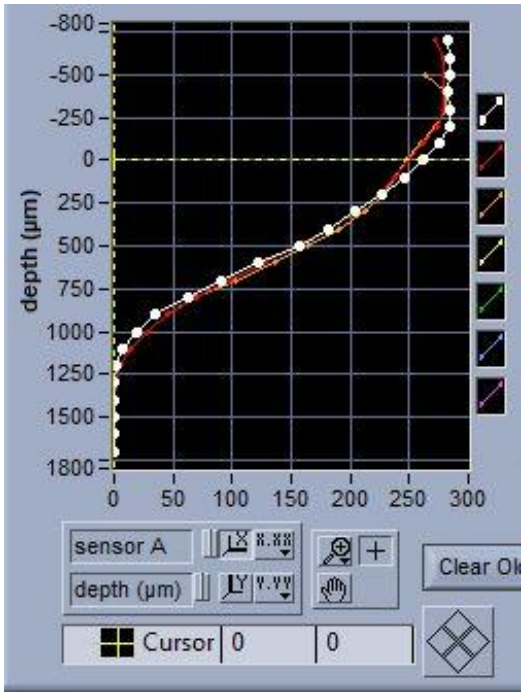
4.7 The Profile Tab

The **Profile** tab is used for the actual microprofiling. It contains at the top a small version of the chart recorders already described for the **Monitor** tab in chapter 4.6. The content of the chart recorders is not saved in the data files. In contrast, the two profile graphs at the bottom show all data points, which are saved, into the data files. To the right of the **Profile** tab, all control elements are located which are used for manual data acquisition, data logging, fast profiling, standard profiling and automated transects.



4.7.1 About Data Points and the Profile Graphs

Profix provides four different possibilities to acquire data: manual data acquisition, logging at defined time intervals, fast and standard profiling. All four options save the acquired data as "data points" into the data files. Each data point is saved in a separate row of the data file, together with an optional comment written by the user in **Comment** during the measurement. The data points are grouped into successive "data sets".



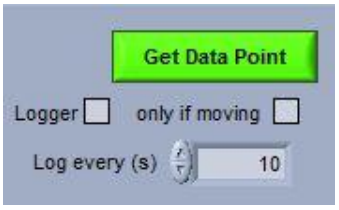
The data points of the last recent 7 data sets are plotted in the profile graphs for sensor A and B, respectively. The y-axis refers to the depth position (µm), where the data points have been acquired. The x-axis refers to the sensor reading. The legend next to the profile graph defines the plot mode of each data set, where the uppermost entry refers to the actual data set. By clicking on an element in the legend, a pop-up menu appears. The items **Common Plots**, **Color**, **Line Width**, **Line Style**, **Point style**, **Interpolation** can be used to change the appearance of the plotted data points (the items Bar Plot, Fill BaseLine, and Y-Scale are not appropriate to this application). With **Clear Oldest Color**, the points of the oldest data set can be removed. By repeatedly pressing this button, all data sets except the current one can be removed. This operation does not affect the data file.

The scaling of the profile graph can be modified by the user as described for the chart recorders (see section 4.6). Additionally, a cursor is available inside the profile graph for reading precise values of data points. The actual position of the cursor can be read in the cursor control panel below the profile graph. In order to move the cursor, click onto the cursor button in the tool panel. Now you can click onto the centre of the cursor and drag it to a new position.

By clicking the cursor mode button a pop-up menu appears. The first three items **Cursor style**, **Point style**, and **Color** can be used to alter the appearance of the cursor. The last two items of the pop-up menu are useful if the cursor is not within the visible part of the profile graph. If you click **Bring to** the cursor will be moved to the centre of this window. Choosing **Go to cursor** will change the ranges of the two axes of the profile graph, so that the cursor appears in the centre.

An additional possibility for moving the cursor is the diamond shaped button. It allows precise single step movements of the cursor in all four directions.

4.7.2 Manual Data Acquisition



The simplest data acquisition is performed by pressing the button **Get Data Point**. One data point is read from each sensor. It is saved directly into the data file and is plotted into the profile graph. A new data set can be created by pressing the button **New Data Set** (see section 4.4).

4.7.3 Logging at Defined Time Intervals

If the **Logger** option is checked, data points will be acquired periodically. The period in seconds has to be set in **Log every (s)**. The minimum period is 1 second. Besides the periodical acquisition, the action of the logger is precisely the same as the action of the **Get Data Point** button (see section 4.7.2).

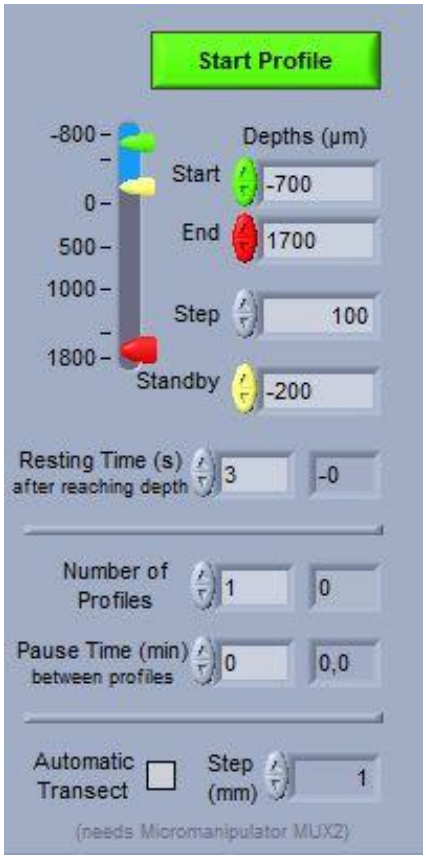
4.7.4 Fast Profiling

NOTE: Precise measurements of profiles should preferably be performed with the standard profiling function as described in the section 4.7.5.

If both the **Logger** and the **only if moving** option are marked, *Profix* acquires data points (as described in section 4.7.3) only while the motor is moving. This option can be used for acquiring a fast profile. A fast profile is acquired by continuously moving the microsensor tip through the sample while sampling data points in defined time intervals. It should be emphasized that the acquired data are not precise for two reasons. The position information for each data point is not well defined due to the time delay of the data transmission from the microsensor module. Secondly, the data acquisition takes place while the sensor tip is moving, so it is not really a point measurement. Generally the quality of the fast profiling is increased by lowering the velocity of the motor.

An example for fast profiling is given in the following: A profile between -500 µm and 2000 µm depth in steps of 100 µm should be acquired. First move the microsensor to a depth of –500 µm by using the **Goto** function of the manual motor control. Adjust the **Velocity** of the motor to 50 µm/s and set a logging interval of 2 seconds in **log every (s)**. These values will yield a fast profile with 100 µm steps between the data points. Now check first the **only if moving** box, followed by checking the **Logger** box. Use the **Goto** button again for moving the microsensor to the depth of 2000 µm. The motor will start moving and the fast profile will be acquired. The acquired data points will be directly viewed in the profile graph. If you want the fast profile to be saved as a separate data set, remember to press **New Data Set** (see section 4.4) before starting the profiling.

4.7.5 Standard Profiling



The lower right area of the **Profile** tab contains all controls for the standard profiling process, i.e. the motor moves the microsensor stepwise through the sample and acquires at each step one or more data points. All depth units are given in micrometer. The following parameters have to be defined before starting a profile. **Start** is the depth where the first data points for the channels A and B are acquired. **End** is the depth where the profiling process finishes. **Step** defines the step size of the profile. When a profile is finished, the microsensor tip is moved to the **Standby depth**.

Because microsensors have a certain response time, the **Resting Time after Reaching Depth** has to be adjusted. It determines the time in seconds the microsensor tip rests after reaching a new depth, before the next data point is read. If several profiles should be acquired automatically, the appropriate **Number of Profiles** can be chosen. The microsensor tip is moved to the **Standby** depth between successive profiles. In **Pause Time** the resting time (in minutes), before the next profile is performed, can be adjusted.

The profiling is started by pressing **Start Profile**. The profiling process can be followed by the five indicators with the dark grey background: The indicator to the right of **Number of Profiles** displays the actual profile number. The other two indicators act as "count-down" indicators, i.e. they show how much time is left of the resting time. The currently active resting time (i.e. either **Resting Time after Reaching Depth** or **Pause Time between Profiles**) is indicated by a red background of the respective "count-down" indicator.

A **STOP Profile** button and a **Pause** button appear during profiling. The profiling process can be aborted at any time by pressing **STOP Profile**. Pressing the **Pause** button causes the profiling process to halt, but it can be resumed any time by pressing the **Resume** button.

4.7.6 Automated Transects

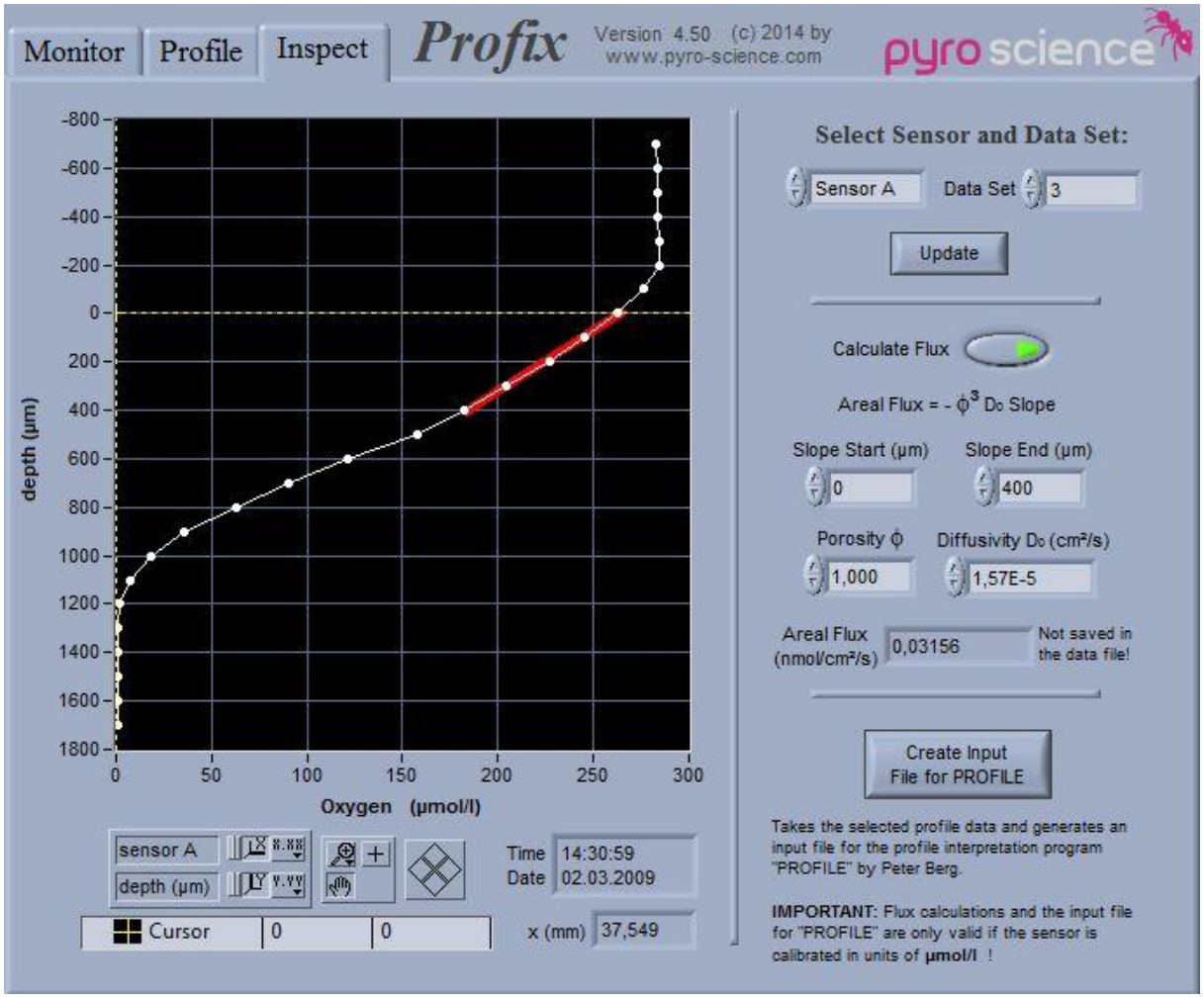
If the micromanipulator is equipped with a motorized x-axis (left-right, e.g. ***MUX2***), ***Profix*** can acquire also automated transects. A transect consists of a series of microprofiles, where the x-position in between each microprofile is moved by a constant step. The following example explains how to acquire an automated transect across e.g. 10 mm with a step size of 2 mm:

1) Enable the **Manual Control** switch (see section 4.3) and use the manual control knob on the motor housing for adjusting the starting x-position of the microsensor. The automated transect will start at this x-position, which will be set to 0 mm in the saved data file.
2) Adjust the parameters of the single profiles as described in the previous section.
3) Check **Automatic Transect**.
4) Adjust **Step (mm)** to 2 mm.
5) Adjust **Number of Profiles** to 6 (corresponding to a total x-displacement of 10 mm for a step size of 2 mm)
6) Press **Start Profile**.

The single microprofiles of the transect are saved in separate data sets (see section 4.4). The x-position of each microprofile is written in the header of each data set.

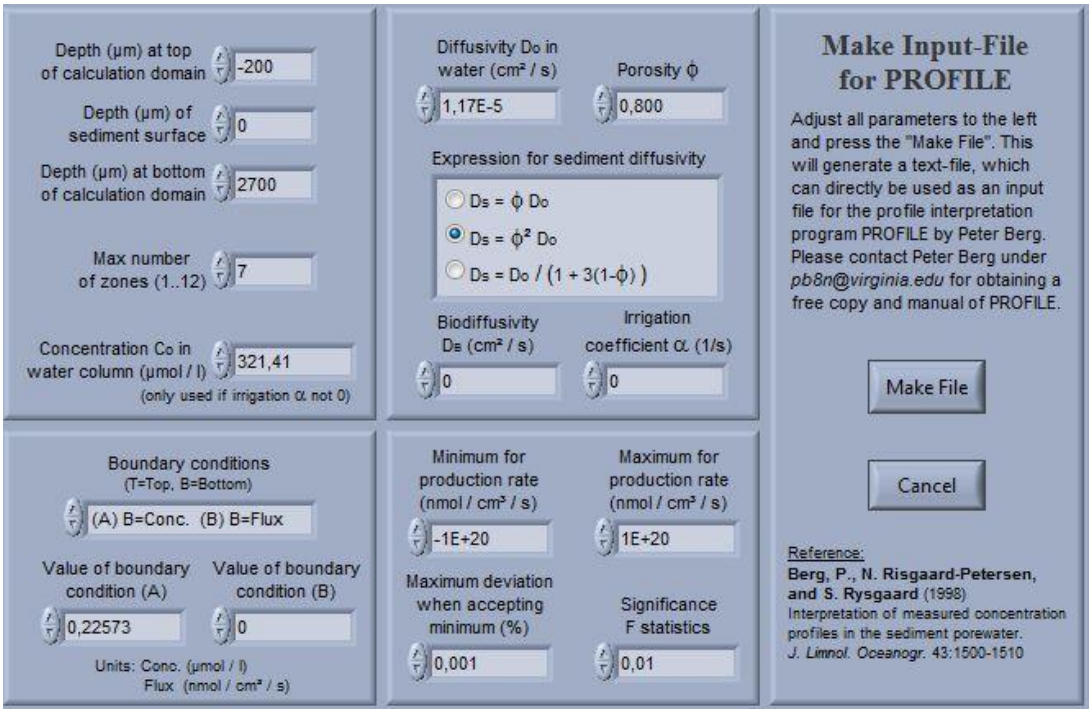
4.8 The Inspect Tab

The **Inspect** tab provides several options for reviewing and analysing acquired data sets. The data set, which should be plotted in the profile graph, is selected in **Sensor A/B** and **Data Set**. The scaling, range, cursor, etc. of the profile graph can be adjusted in the same manner as already described for the profile graphs in the **Profile** tab (see section 4.7.1). If older data files should be inspected, the user has to open the respective files by pressing the **Select File** button and choosing "append data file" (see section 4.4). Pressing the **Update** button will refresh the graphs after a new file has been selected.



The inspect tab provides a simple way for calculating areal fluxes with help of a linear regression. Enter the depths for the **Slope Start** and the **Slope End** defining the depth interval of the linear regression. Click the **Calculate Flux** button and the result of the linear regression is shown in the plot as a thick red line. By adjusting the **Porosity** and the **Diffusivity Do** the calculated areal flux will be shown in **Areal Flux.** Note that these calculations are NOT saved to the data file!

By pressing **Create Input File for PROFILE** it is possible to generate for the currently shown profile an input file for the profile analysis program "**PROFILE**" from Peter Berg:


Depth (µm) at top of calculation domain
-200
Depth (µm) of sediment surface
0
Depth (µm) at bottom of calculation domain
2700
Max number of zones (1..12)
7
Concentration Co in water column (µmol / l)
321,41
(only used if irrigation α not 0)
Diffusivity Do in water (cm² / s)
1,17E-5
Porosity ϕ
0,800
Expression for sediment diffusivity
Ds = ϕ Do
Ds = ϕ² Do
Ds = Do / (1 + 3(1-ϕ))
Biodiffusivity Ds (cm² / s)
0
Irrigation coefficient α (1/s)
0
Make Input-File for PROFILE
Adjust all parameters to the left and press the "Make File". This will generate a text-file, which can directly be used as an input file for the profile interpretation program PROFILE by Peter Berg. Please contact Peter Berg under pb8n@virginia.edu for obtaining a free copy and manual of PROFILE.
Make File
Cancel
Reference:
Berg, P., N. Risgaard-Petersen, and S. Rysgaard (1998) Interpretation of measured concentration profiles in the sediment porewater. J. Limnol. Oceanogr. 43:1500-1510
Boundary conditions (T=Top, B=Bottom)
(A) B=Conc. (B) B=Flux
Value of boundary condition (A)
0,22573
Value of boundary condition (B)
0
Units: Conc. (µmol / l) Flux (nmol / cm² / s)
Minimum for production rate (nmol / cm³ / s)
-1E+20
Maximum for production rate (nmol / cm³ / s)
1E+20
Maximum deviation when accepting minimum (%)
0,001
Significance F statistics
0,01

Refer to the **PROFILE** manual for details about adjusting the parameters. Please contact Peter Berg under pb8n@virginia.edu for obtaining a free copy and documentation of his **PROFILE**-software.

5 Technical Specifications

System requirements	PC with Windows 2000/ XP/ Vista/7/8
	Processor with >1.8 GHz
	200 MB free hard disk space
Updates	Updates can be downloaded at:
	http://www.pyro-science.com